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1.0 PURPOSE/SCOPE

An Alkali Metal Transfer System provides a facility for liquid metal transfer from a supply container to either a receiver container or a heat pipe. Liquid metal transfer is a non-continuous operation and is conducted to satisfy heat-pipe filling requirements.

2.0 LOCATION

This operating procedure covers the Alkali Metal Transfer System activities within the ESA-EPE Process Controls Team at TA-46, Building 1, South and North High-Bay areas.

3.0 HAZARD CONTROL PLAN REFERENCE

This procedure is for use with the Thermal Engineering Team Hazard Control Plan (HCP), ESA-EPE:HCP:00-007.0.

All hazards, controls, risk assessment, required training, and worker authorization are covered under the HCP. Workers performing this procedure must understand all hazards and controls and be authorized to perform work under the above HCP.

4.0 MATERIALS AND TOOLS

The following are required to perform this procedure:

Lab Supplies:

Supply container, receiver container, a vacuum pump, valves, and gas-supply tank (see flow diagram below); dry chemical fire extinguisher, Material Safety Data Sheets.

Chemicals:

Ethanol 190, vacuum pump oil

Compressed Gases:

Argon, helium, nitrogen

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following PPE must be worn during preparation, performance and clean-up for this procedure:

Face shield, goggles, thermal gloves, long-sleeved lab coat, and safety shoes.

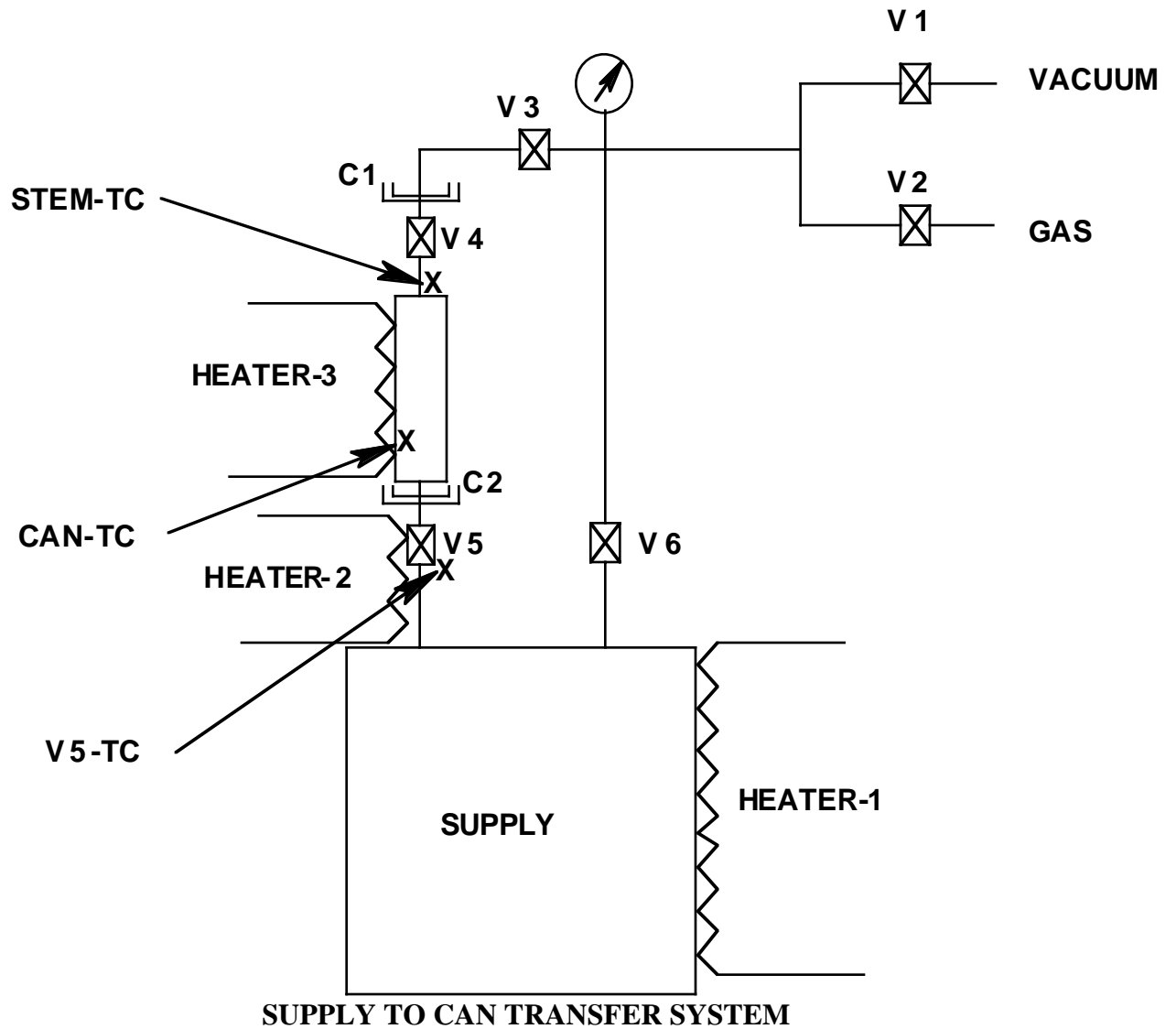
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6.0 PROCEDURES FOR FILLING CAN

See figure below for filling setup. Locations of thermally heated surfaces will be clearly defined and the surface will be shielded or guarded.

- 6.1 Close v1, v2 and v3.
- 6.2 Connect can/v4 assembly to line at connection c1.
- 6.3 Preset gas supply at 5 psi at bottle regulator.
- 6.4 Open v2, v3 and v4, insure gas flow through can.
- 6.5 Remove cap from connector at c2 and connect can/v4 assembly to pre-assembled supply system.
- 6.6 Close v2, open v1 and evacuate can using a roughing pump.
- 6.7 Preheat can to 100°C for Potassium, 150°C for Sodium and 250°C for Lithium. (heater-3)
- 6.8 Preheat v5-tc to 115°C for Potassium, 170°C for Sodium and 350°C for Lithium.(heater-2)
- 6.9 Preheat supply to 150-200°C for Potassium, 200-250°C for Sodium and 350-400°C for Lithium.
- 6.10 Preset gas supply at 12 psi, close v4, v3 and v1, open v2 and v6.
- 6.11 Open v5 and monitor temperature rise in stem-tc indicating filling of can.
- 6.12 Close v5, v6 and v2, deactivate heater-2 and heater-3.
- 6.13 Allow can to cool to room temperature and remove.

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7.0 PROCEDURES FOR DUMPING CAN

See figure below for dumping setup.

- 7.1 Close v1, v2 and v3.
- 7.2 Preset gas pressure at 3-5psi at bottle regulator.
- 7.3 Open v3 and v1, insure flow at connector c1
- 7.4 Connect heat pipe at connector c1.
- 7.5 Remove plug at connector c2, insure flow at c2.
- 7.6 Connect can/v4 assembly at connector c2.
- 7.7 Close v3 and open v2 to roughing pump.
- 7.8 Preset TC-1 at 65°C for Potassium, 100°C for Sodium, and 190°C for Lithium.
- 7.9 Preset TC-2 and TC-3 at 120°C for Potassium, 200°C for Sodium, and 300°C for Lithium.
- 7.10 Connect gas line to v4, pressure still set at 3-5 psi.
- 7.11 Open v4 and monitor vacuum gage for indication of dump and gas flow.
- 7.12 If no change in vacuum pressure, heat v4 with heat gun until pressure change.
- 7.13 Once pressure change is noticed close v4.
- 7.14 Deactivate all heaters and allow all thermocouples to get below 50°C.
- 7.15 Remove gas line from v4 and connect to v3.
- 7.16 Close v2 and open v3.
- 7.17 Remove can/v4 assembly at c2 and insure flow through connector.
- 7.18 Cap c2.
- 7.19 Close v3 and open v2, switch to high vacuum pump at 50 Torr.
- 7.20 Proceed to Section 8.0 for Sodium or Potassium distillation or to Section 9.0 for Lithium distillation

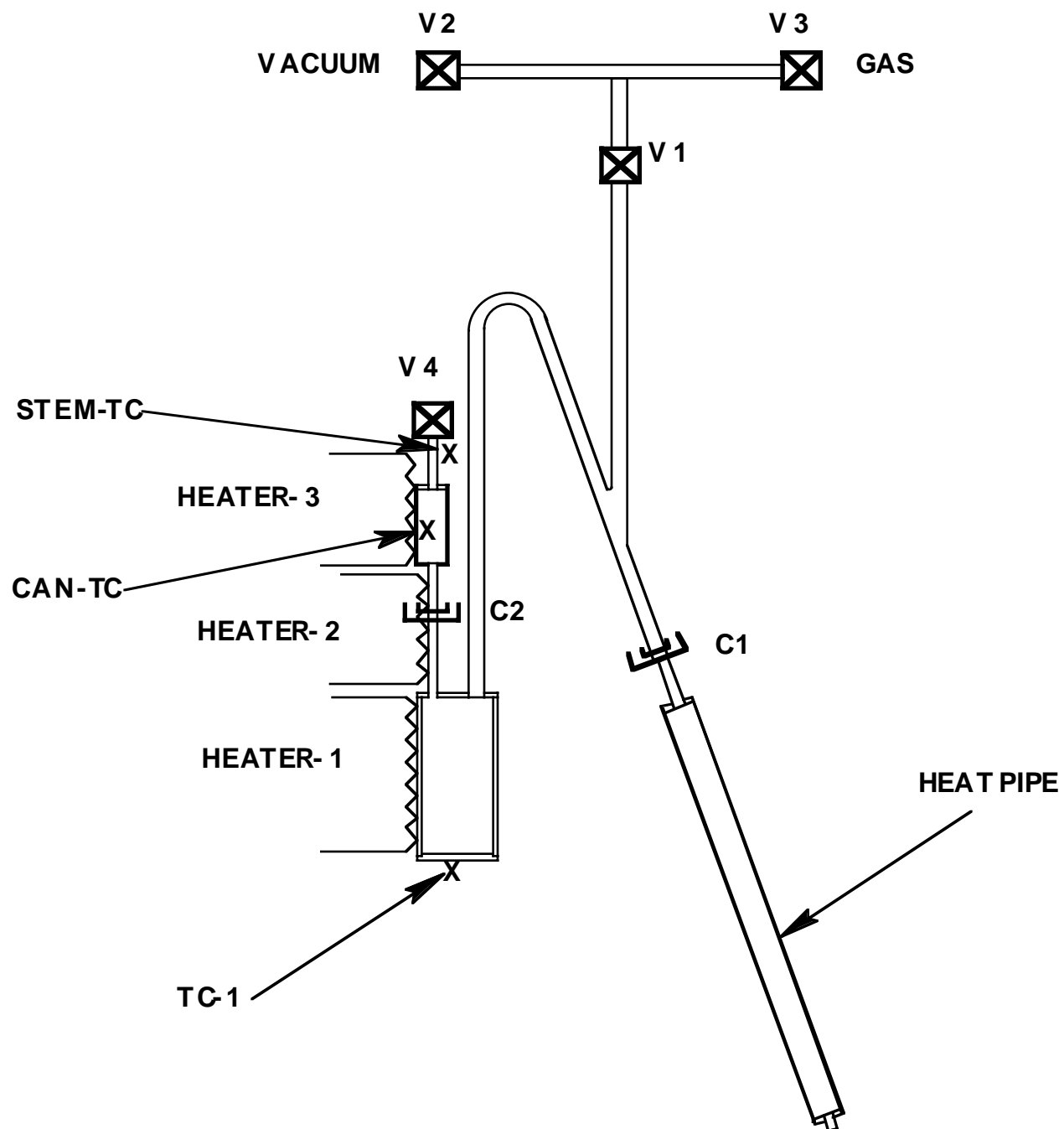
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8.0 PROCEDURES FOR SODIUM AND POTASSIUM DISTILLATION

See figure below for distillation setup.

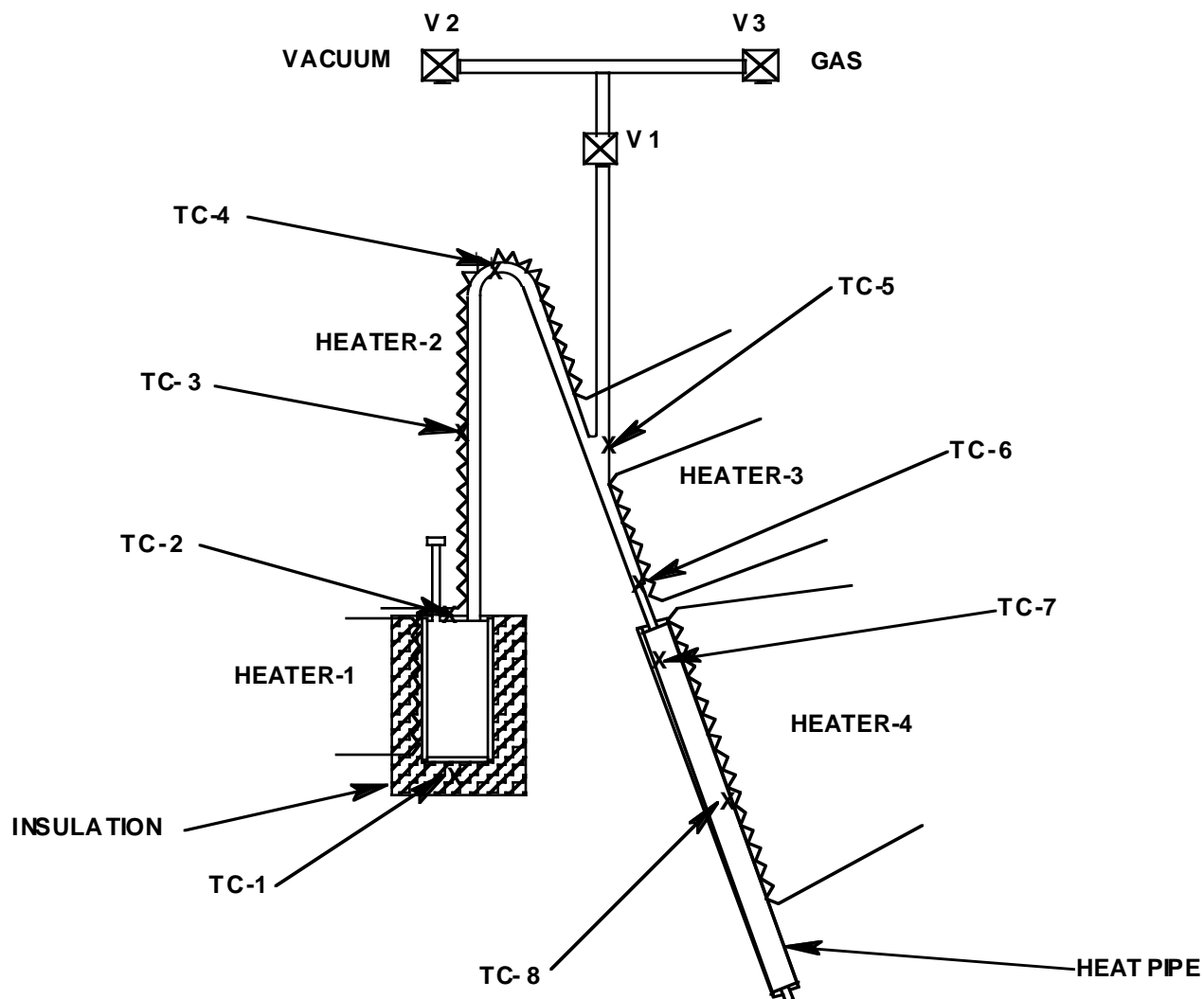
- 8.1 Spot weld all thermocouples.
- 8.2 Wrap heater and insulation as shown.
- 8.3 Preset TC-3, TC4, TC5 and TC6 at 150°C for Potassium and at 250°C for Sodium.
- 8.4 Preset TC7 and TC8 at 70°C for Potassium and at 100°C for Sodium.
- 8.5 Activate heater-1 and maintain vacuum pressure at 10^{-6} Torr.
- 8.6 Increase heater-1 until TC-1 and TC-2 are at 450°C max for Potassium and 550°C max for Sodium, insure vacuum pressure is at 10^{-6} Torr.
- 8.7 TC-3, TC-4, TC-5 and TC-6 will increase during distillation.
- 8.8 Distillation is complete with a rise in temperature at TC-1 and decrease in temperature at the rest of the thermocouples indicating complete transfer of alkali metal.
- 8.9 Turn all heaters off and allow all thermocouples to get below 50°C.

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ALKALI METAL DUMPING SETUP

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POTASSIUM AND SODIUM DISTILLATION SETUP

9.0 PROCEDURES FOR LITHIUM DISTILLATION

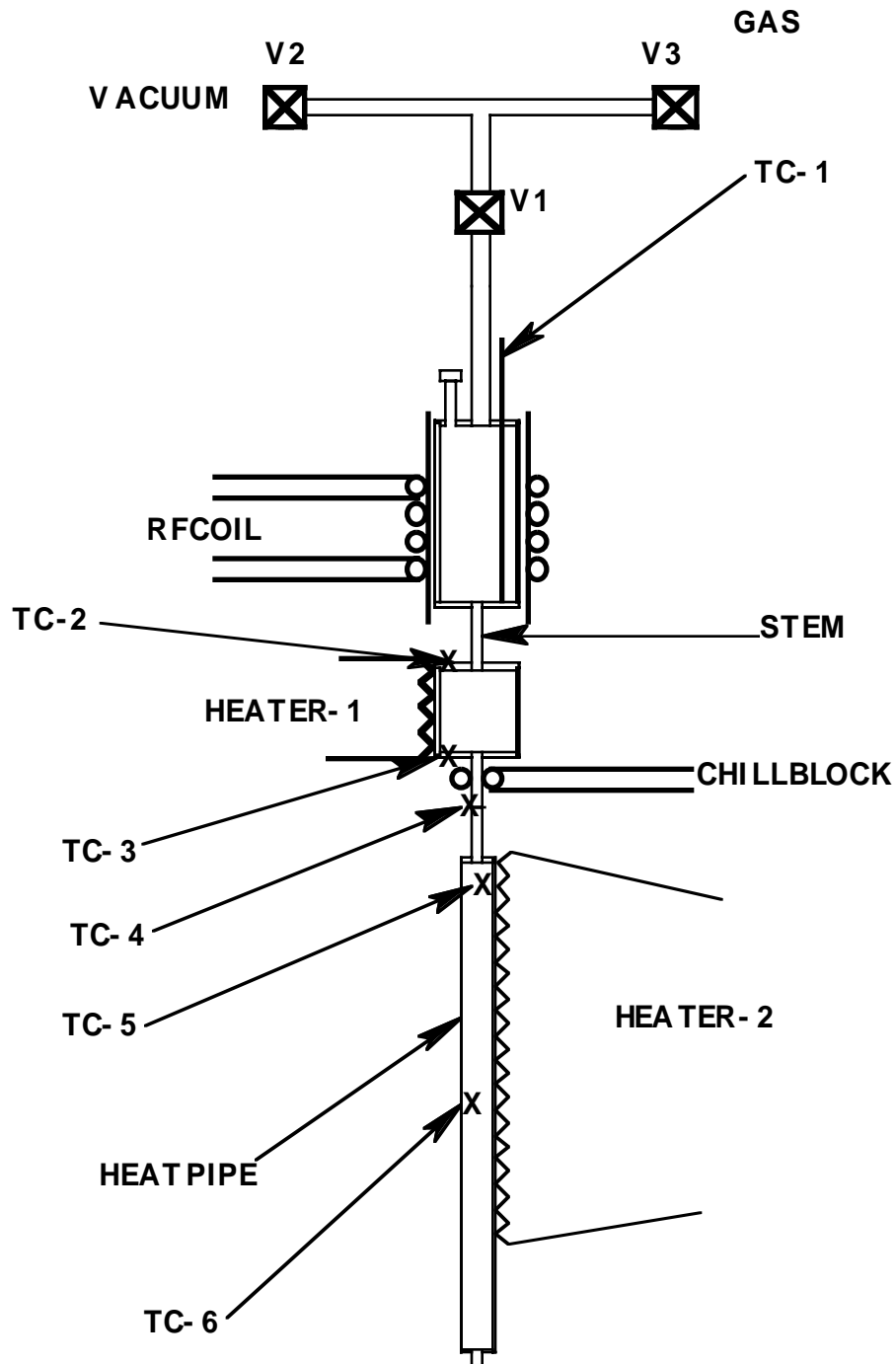
See figure below for distillation setup.

- 9.1 Attach chill block and turn cooling water on.
- 9.2 Heat TC-2 to 215°C and TC-3 to 185°C.(heater-1)

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- 9.3 Heat TC-1 to 725°C, rf coil, insure vacuum pressure is at 10^{-6} Torr.
- 9.4 Close v1.
- 9.5 Increase TC-1 to 950°C.
- 9.6 Stem will be visibly hot as vapor moves into pot.
- 9.7 Maintain TC-1 at 950°C until stem fills. Distillation is complete when stem becomes colder, visibly dark.
- 9.8 Decrease TC-1 to 600°C.
- 9.9 Heat TC-2 and TC-3 to 300°C.
- 9.10 Heat TC-5 and TC-6 to 225°C.
- 9.11 Remove chill block. Removing chill block will allow the full pot to dump into heat pipe.
- 9.12 Dump is complete as vapor once again replaces liquid as the liquid drains from the stem above the pot.
- 9.13 Turn all heaters off and allow all thermocouples to reach 50°C.

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LITHIUM DISTILLATION SETUP